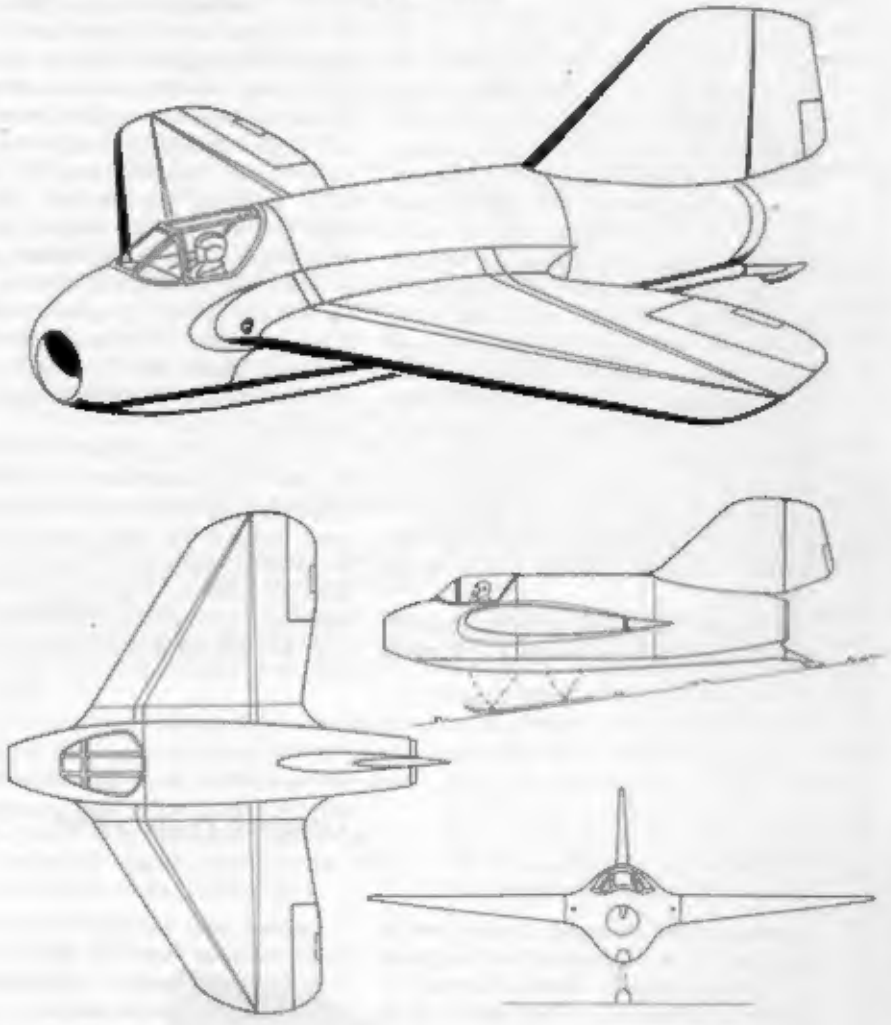
aerodynamic principles. Taken together, these should have given the aircraft excellent flight characteristics, which unfortunately it is now impossible to substantiate due to a complete lack of performance data.

These projects represent the first tail-less aircraft to be powered by jet propulsion. The tests on wing sweep carried out at this time in the wind tunnel of the Aerodynamische Versuchsanstalt (AVA – Aerodynamic Research Institute) in Göttingen were almost certainly used as a basis for the design.

Initially, as a military variant of the Me 163 experimental aircraft, the P.01 was given the RLM designation 8-263. Then in 1941 it received the designation Me 327. But when the experimental aircraft was finally designated the Me 163A, and the direct operational derivative became the Me 163B, the RLM number 263 was allocated to the further development of the latter. In the autumn of 1944 project Me 327 was cancelled in favour of the Me 163B.

Armed Me 163A within project P.01

The origins of the Me 163A experimental aircraft, which made its first unpowered flight on 13th February 1941, lay in the DFS 39. Construction of the Me 163A was carried out by Lippisch and his team in the spring and summer of 1939. When Lippisch received the first, still vague, details of the turbojet engine, he produced an initial study in April 1939 for a small experimental aircraft featuring a nose intake and an unusual – for him – short span wing layout somewhat reminiscent of the Lockheed F-104 Starfighter.



Dimensions			
Span		7.50m	24ft 7in
Sweep*		approx 24°	
Wing area		19m²	204ft²
Aspect ratio		2.96 : 1	
Length overall		6.60m	21ft 7in
Height overall		3.20m	10ft 6in
*reduced sweep in region of the aileron			
Weights			
Empty equipped		2,200kg	4,850lb
Loaded weight		4,270kg with	9,413lb with
		2,100 litres of fuel	461 gallons of fuel
	Me 163A	2,400kg	5,291lb
Initial wing loading		225kg/m²	46lb/ft²
	Me 163B	205kg/m²	41.5lb/ft²
Performance	No data available		
Armament			
Two 15mm MG 151 cannon in wing roots			

Lippisch P.01-111

20th October 1939

In a speech delivered in July 1965, Dr Lippisch explained that this design was, in effect, an armed version of the Me 163A. The powerplant was to be an early Junkers turbojet as conceived by Max Adolf Müller. The wing displayed the usual Department 'L' (the Lippisch design bureau) form and sweep, albeit with a smaller aspect ratio when compared to the Me 163A. See specification table to left.

Lippisch Delta VI twin-jet single-seat fighter

February 1944

At Augsburg in the late summer of 1942 Alexander Lippisch was working on the P.11 twin-jet fast bomber, designed to carry a weapon load of 1,000kg (2,204lb). A number of variants were proposed, both with and without horizontal tail surfaces, before the P.11 Schnellbomber (Fast Bomber) emerged in its final form in May 1943. But when the Technische Amt in Berlin decided in favour of the Horten brothers' Proposal IX, Lippisch ceased work on the P.11.

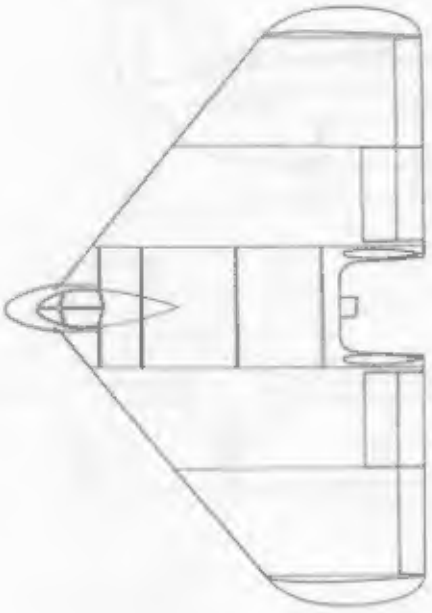
In August 1943 he then received an official contract from the RLM to develop a 'Very Fast Bomber' to be based on his earlier research. Lippisch designed a pure delta-winged aircraft with a straight trailing edge. This initially continued to run under the designation P.11. As before, the powerplant was to be a pair of Junkers Jumo 004 turbojets. With the completion of design work on an unpowered glider which was to serve as the initial prototype (V1) for the operational model, the project was renamed 'Delta VI'. At the same time the RLM began to re-exert pressure, bestowing the highest 'DE' priority on the delta which was now to be produced in a fighter version as well. The LFA constructed models and mock-ups, carried out wind tunnel tests and slowly made ready for production.

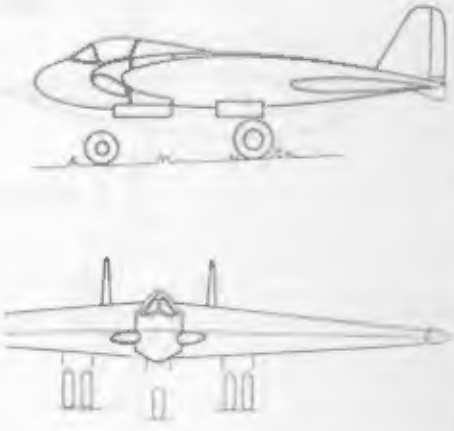
By February 1944 design work on the Delta VI V2, the prototype for the proposed fighter, fighter-bomber and Zerstörer (heavy fighter) models, was nearly complete. It was intended that the actual construction of the four contracted prototypes was to be undertaken by the Henschel works in Berlin. But this remained an intention only. After a lot of to-ing and fro-ing, Lippisch seized the initiative and began building the glider in Vienna at the beginning of 1945. The centre section of the Delta VI V1, the only part of the aircraft to have been completed by the capitulation, fell into the hands of the Americans at Salzburg.

The design and construction of the airframe proved of considerable interest: In contrast to the Delta VI glider, which was built entirely of high grade plywood, the remaining three prototypes were to be of rigid monocoque construction, as were the operational models when series production commenced. Neither variant made use of a load bearing frame. The stressed skin, formed in simple fashion around a mould, consisted of a filler layer between two outer load bearing layers. The layers were made of Dynal and Tronal, two synthetics developed by Dynamit Nobel of Troisdorf. The synthetics content of the airframe was between 50 and 60%. The aerodynamic shape, the method of construction and the materials used gave the aircraft what would become known as good 'Stealth' characteristics.

The low wing loading promised not only a good climb capability, but also excellent manoeuvrability. From his previous experience with delta-winged aircraft, Lippisch ruled out any danger of a propensity to spin.

On 31st January 1944 Lippisch expressed the hope of being able to commence flight tests with the unpowered glider in April/May; the Delta VI V2, powered by two Jumo 004B turbojets, then being ready to fly in July 1944. By the end of 1944 Henschel had still not begun construction of the prototypes and disagreements between the Berlin firm and Vienna grew increasingly bitter. Nothing is known of the reasons for the delay.





Powerplant

Two Junkers Jumo 004B each rated at 900kP (1,984lb) static thrust, plus four RI-503 solid fuel booster rockets, each of 2,000kP (4,409lb) rated thrust, to assist take-off. The installation of the powerplant was such that, as with the Horten Ho IX, it could not be exchanged for other units without costly modification.

Dimensions

Span	10.40m	33ft 5in
Sweep	37°, leading edge	
Wing area	50.6m²	539ft²
Aspect ratio	2.53 : 1	
Wing profile	relative thickness of 17% at the wing root and 9% at the wing tip	
Length overall	7.85m	24ft 6in
Height overall	2.70m	9ft 0in

Weights	(F=fighter, FB=fighter-bomber, Z=Zerstörer)	
Airframe	F	2,000kg (approx)	4,409lb
Loaded	F	7,200kg	16,005lb
		with 2,600 litres	with 951 gallons
		of fuel in wing	of fuel in wing
Max loaded wt	FB & Z	8,600kg	17,630lb
Max wing loading	FB	143kg/m²	29.7lb/ft²
	Z	160kg/m²	32.7lb/ft²

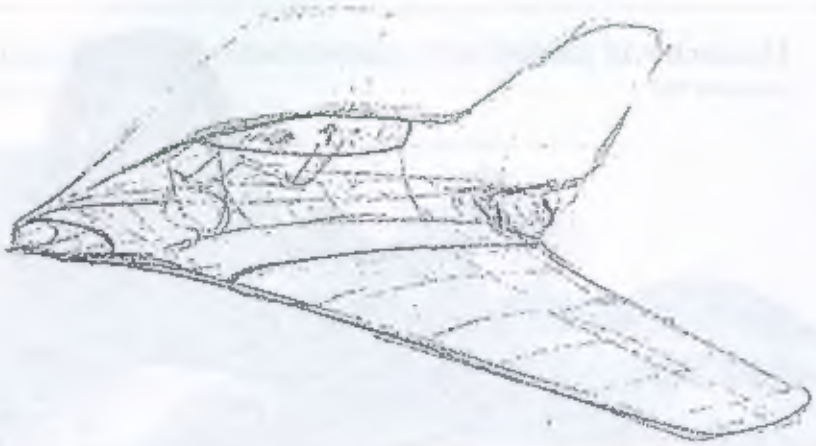
Performance

Max speed	1,040km/h	646mph at
	at 6,000 to 8,000m	19,750 to 26,250ft
Time to height	15min to 10,000m	32,800ft
Range at 8,000-10,000m	approx 3,000km	1,864 miles

Armament

Two 30mm MK 103 wing-mounted cannon; plus provision for additional two 30mm MK 103 cannon or one 75mm BK 7.5 or Duka 73 heavy cannon in external pack(s). Weapon load: max 1,000kg (2,200lb).

Sketch in Lippisch's hand showing the initial thinking around the P.15.



Artist's view of the initial P.15 developed from Professor Lippisch's sketch.

MESSERSCHMITT

The aviation industrialist and designer Willy Messerschmitt played an outstanding role in the creation of the jet fighter from the very beginning. As early as 1940 the RLM had directed him to develop his P.1065 project, which would eventually result in the Me 262. At the same time his project bureau put forward plans for the P.1070. Compared to the P.1065, this was a somewhat smaller, but appreciably lighter and aerodynamically more sophisticated design, parts of which (eg wing structure and nosewheel) would also later be incorporated into the definitive Me 262.

After these initial projects not a lot happened. Urgent war work, together with Göring's ban on development, were having their effect. It was not until some years later that further fighter proposals would be made. At the beginning of 1943, despite nearly all its resources being occupied in the series production of such types as the Me 262 and Me 163, in research work on the Me 328 pulse-jet fighter and Me 264 long range bomber, and in the continuing development and upgrading of the Bf109, the company was to launch a new phase in jet aircraft development. Messerschmitt firmly believed that Germany could get by with, and should concentrate on, just one tenth of the number of aircraft types currently in series production. With his P.1090 and P.1092 projects, and his plans for possible other roles for the Me 262, he was, in fact, proposing the adoption of pure multi-purpose aircraft programmes. It was out of further design work on the P.1092 multi-purpose weapons system that a whole range of proposals for single-jet air superiority fighters was to originate.

In mid-1944, a good 12 months later, the chief of the project bureau, Dipl-Ing Woldemar Voigt, and the head of feasibility studies, Dipl-Ing Hans Hornung, used these proposals as a basis to start work on a single-jet successor to the Me 262.

Via projects P.1101 – of which an experimental prototype was built at Oberammergau – and P.1106, the way finally led to the advanced P.1110, P.1111 and P.1112 designs. These represented a wide spectrum of ideas and solutions which anticipated much of what was to become state-of-the-art technology for decades after the war. The victorious powers saved themselves colossal sums in research and development costs.

Gotha P.60A heavy fighter

January 1945

The Gotha P.60 heavy fighter the project resulted from the development work carried out by the Gotha company on the Horten Ho IX. This was initially intended to culminate in series production as a structurally improved Go 229.

Gotha was requested by the Oberkommando der Luftwaffe (OKL – Luftwaffe High Command) to incorporate the experience gained from the Horten Ho IX/Go 229 into a new design.

OKL requirements included:

- A crew of two.
- A pressure sealed high altitude cabin.
- A standard tricycle undercarriage.
- A greater range than the Go 229.
- The option of installing more powerful engines.

Gotha's head of design, Ing Hünerjäger, and his chief aerodynamicist, Dr Göthert, also incorporated the latest high speed research into their design, a move which was not accepted without a certain amount of reservation by Walter and Reimar Horten. They also evaluated the most recent developments in alternative construction and the running and operation of turbojet engines.

Structurally, the P.60A and P.60B were identical. The crew was accommodated in a prone position in a pressure sealed cabin fully faired into the nose contours. The airframe consisted of a plywood-skinned tubular steel centre section structure with all-wooden, lattice work outer wings.

Elevators and ailerons were combined in the one control surface (elevon) on the trailing edge of each outermost wing section. Rudder control was provided in a highly unusual manner; two telescopic control surfaces being simultaneously extended above and below each wingtip. Fuel was carried in the outer wings and in a centre-section tank.

Crew

One pilot and one radio operator/navigator in prone position.

Powerplant

Two BMW 003 each rated at 800kP (1,763lb) static thrust.

Dimensions		
Span	12.40m	40ft 8in
Sweep	40° at 0.25 chord	
Wing area	46.8m²	503ft²
Length overall	9.50m	31ft 2in
Height overall	3.13m	10ft 4in

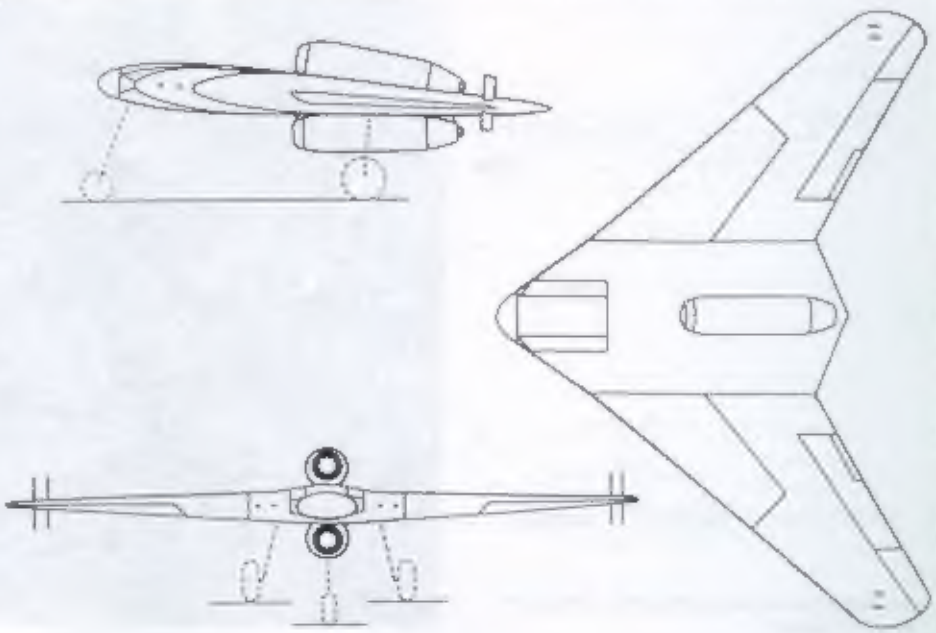
Weights		
Empty equipped	4,190kg	9,237lb
Loaded	7,450kg with approx 2,500 litres of fuel	16,424lb with approx 550 gallons of fuel

Performance		
Max speed	915km/h at 7,000m	568mph at 20,000ft
Initial rate of climb	14m/sec	4,685ft/sec
Service ceiling	12,500m	41,000ft
Time to 5,000m	14.1 minutes	26,250ft
Time to 10,000m	21.5 minutes	32,800ft
Endurance at 100% thrust	approx 2 hours at 12,000m	39,000ft
Range at 100% thrust	approx 1,600km at 12,000m	994 miles 39,000ft

Armament

As heavy fighter: Four 30mm MK 108 or two 30mm MK 103 cannon in wing centre section to left and right of crew cabin.

As reconnaissance aircraft (secondary role): Two RBs 50/18 cameras.



Gotha P.60B heavy fighter

March 1945

On 28th February 1945 the General der Jagdflieger (Air Officer Commanding Fighters) laid down new requirements for both single- and twin-jet fighter projects.

His demands included, among other things, a more comprehensive equipment fit and, above all, a greater endurance. Take-off on grass should not exceed 1,000m (3,250ft). Ing Hünerjäger and Dr Göthert therefore decided to enlarge their original P.60 design into the P.60B, while still continuing development of the former as an 'immediate solution' under the designation P.60A as described above.

The company proposed a third variant, designated the P.60C, as their tender to the night fighter specification issued on 27th January 1945. But the capitulation of Germany in May perforce denied the designers and aerodynamicists of the Gothaer Waggonfabrik any practical demonstration of their ideas and proposals. It is only today, after decades of being a mere pipe dream, that the aerodynamic planform championed back in 1945 has re-emerged centre stage in the shape of America's so-called 'stealth' bomber, the Northrop B-2A Spirit.

Crew
Pilot and radio operator in pressure sealed cabin.

Powerplant
Two Heinkel HeS 011 turbojets each rated at 1,300kP (2,865lb) static thrust. Provision for additional 2,000kP (4,409lb) thrust rocket motor.

Data below for the heavy fighter variant unless given with an 'R' for the reconnaissance (secondary) role

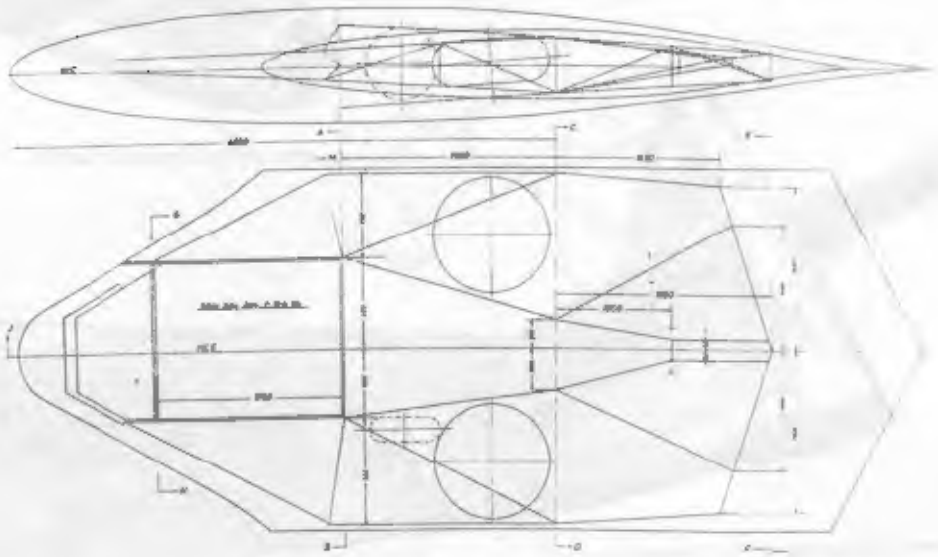
Dimensions			
Span		13.50m	44ft 3¼in
Sweep		40° at 0.25 chord	
Wing area		54.7m²	588ft²
Aspect ratio		3.3 : 1	
Length overall		9.90m	32ft 5in
Height overall		3.56m	11ft 6in

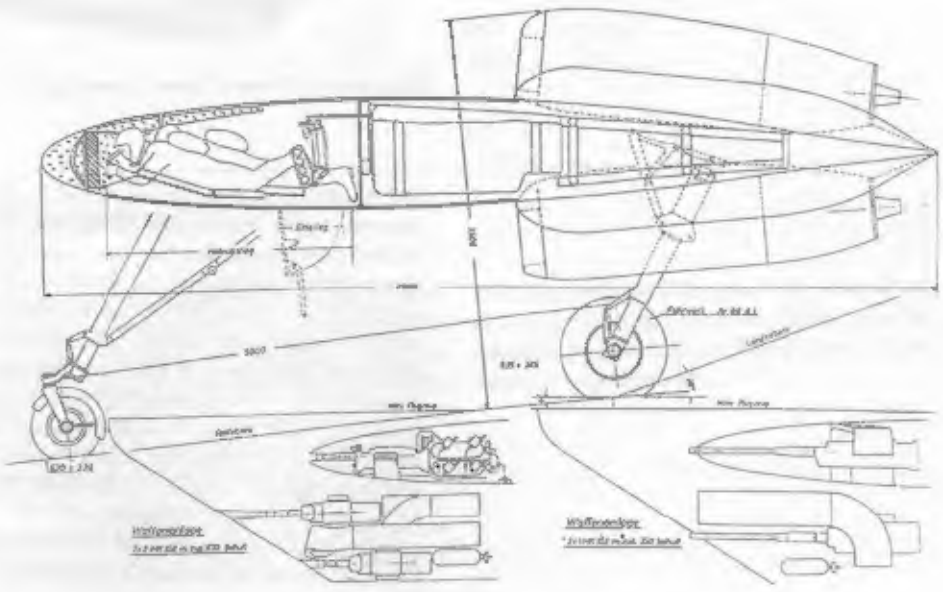
Weights			
Empty equipped		3,161kg	11,377lb
Loaded		9,953kg with	21,942lb with
		3,500kg of jet fuel	7,716lb of jet fuel
Loaded (max)	R	11,000kg with	24,250lb with
		2,600kg of jet fuel	5,731lb of jet fuel
		plus 1,700kg	plus 3,747lb
		of rocket fuel	of rocket fuel
Max wing loading		182kg/m²	37.2lb/ft²
	R	201kg/m²	41lb/ft²

Performance			
Max speed		900km/h at 6,000m	680mph at 20,000ft
Initial rate of climb		19m/sec	3741/sec
	R	60m/sec	1968/sec
Time to height	30.5 min	to 14,000m	46,000ft
	R 2.6 min	to 9,000m	29,500ft
Max Endurance	2.4 hrs	at 14,000m	46,000ft
	R 3.7 hrs	at 14,000m	46,000ft
Max Range		approx 2,800km +	1,739 miles +
		at 14,000m	46,000ft
	R	2,100km	1,304 miles
		at 14,000m	46,000ft

Armament
As Heavy Fighter:
Four 30mm MK 108 or four 30mm MK 213C cannon in wing centre section to left and right of crew cabin. Weapon load: provision for weapons racks. As reconnaissance aircraft (secondary role): one Rb 50/18 and One Rb 30/18 cameras.

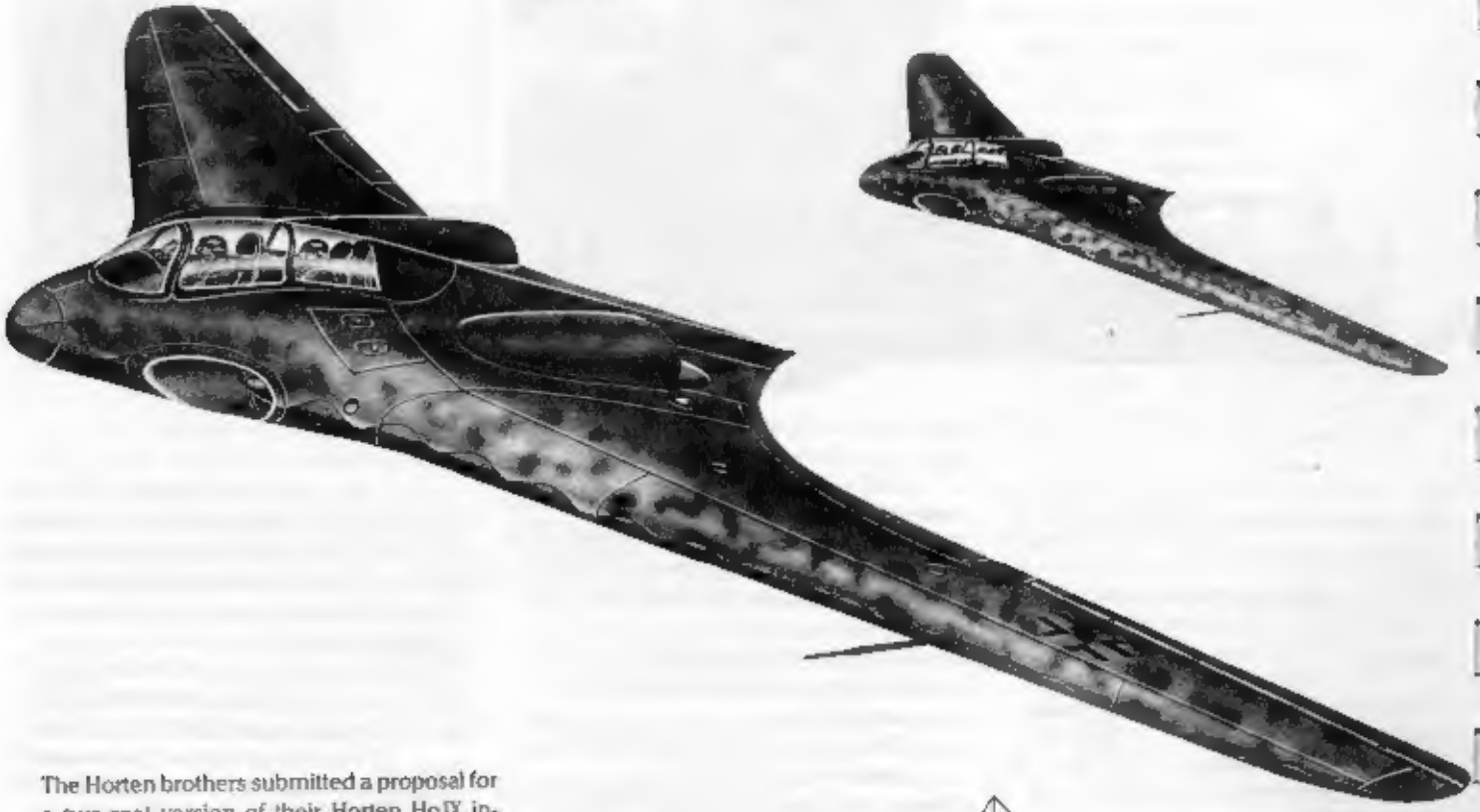
Radio equipment
FuG 15 R/T. FuG 25a FF and FuG 125 radio beacon receiver.





Horten Ho IXb (8-229B-1/Go 229B)

1st March 1945

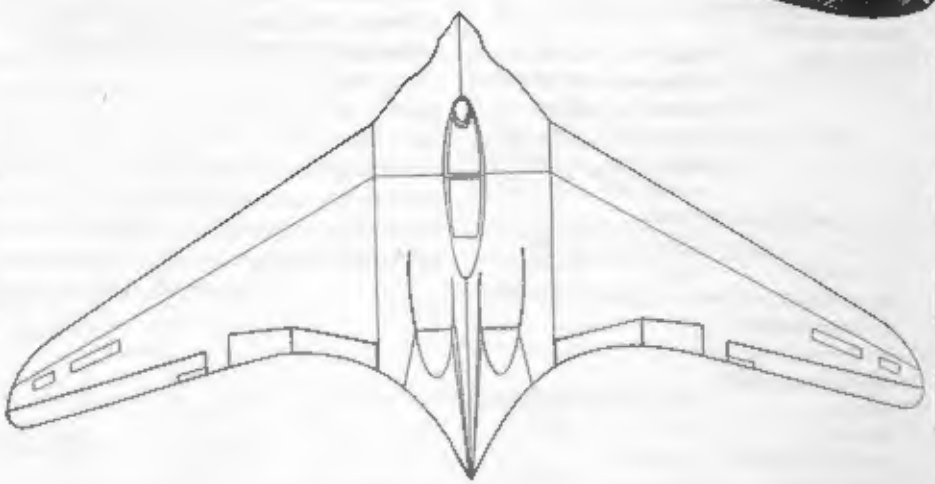


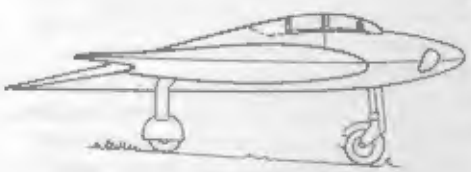
The Horten brothers submitted a proposal for a two-seat version of their Horten Ho IX intended, among other roles, for service as a night fighter. Shortly thereafter this small company received specifications from the TLR for an 'all-weather day and night fighter'

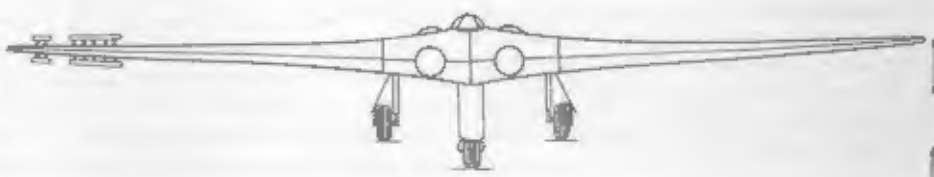
As an 'immediate solution' the night fighter variant of the two-seat multi-purpose aircraft had a decided advantage over such types as the Ar 234P-5, Do 335B-6 or Me 262B-2 in that it would be built almost entirely of tubular steel and plywood and thus at appreciably less cost. Nor was that by any means all. In 1950 Dr Reimar Horten was to say of his design: *As wooden surfaces offer very little reflection to electric waves, they are almost invisible on the radar screen. And as a fighter pilot must, and should, utilise the element of surprise to the full, especially by night, so should his aircraft be constructed of wood...*

The Hortens had also listed other advantages in their original submission, such as higher speed, lower wing loading, good climb capability and, not least, considerably extended endurance; each and every one of particular import for a night fighter.

The Horten Ho IX V6 was to be the prototype for the two-seater variant. Partial assembly had already begun prior to the Reich's capitulation. Under even halfway normal circumstances, the chances of series production would not have been bad. Göring for one was a firm believer in the two brothers' work.







Crew
Pilot and radar operator/observer in ejection seats in armoured pressure cabin.

Powerplant
Two Junkers Jumo 004B-2 turbojets each rated at 910kP (2,006lb) thrust. Alternative option of two BMW 003A-1 each rated at 800kP (1,763lb) static thrust. (For structural reasons installation of the Heinkel HeS 011 could only have been carried out with the greatest difficulty.)
Two 1,000kP (2,204lb) take-off rockets as additional field conversion set.

Dimensions

Span	16.76m	54ft 10¹/₂in
Sweep	39°	
Wing area	53.6m²	576.9ft²
Aspect ratio	5.2 : 1	
Length overall, approx	8.50m	27ft 10¹/₂in
Height overall	3.05m	10ft 0in

Weights

Empty equipped	5,200kg	11,463lb
Normal loaded	8,650kg with	19,069lb with
	1,850kg of fuel	4,078lb of fuel
Max loaded	10,500kg with	23,148lb with
	3,500kg of fuel	7,716lb of fuel
Max wing loading	196kg/m²	40lb/ft²

Performance
At normal take-off weight with two Jumo 004s.

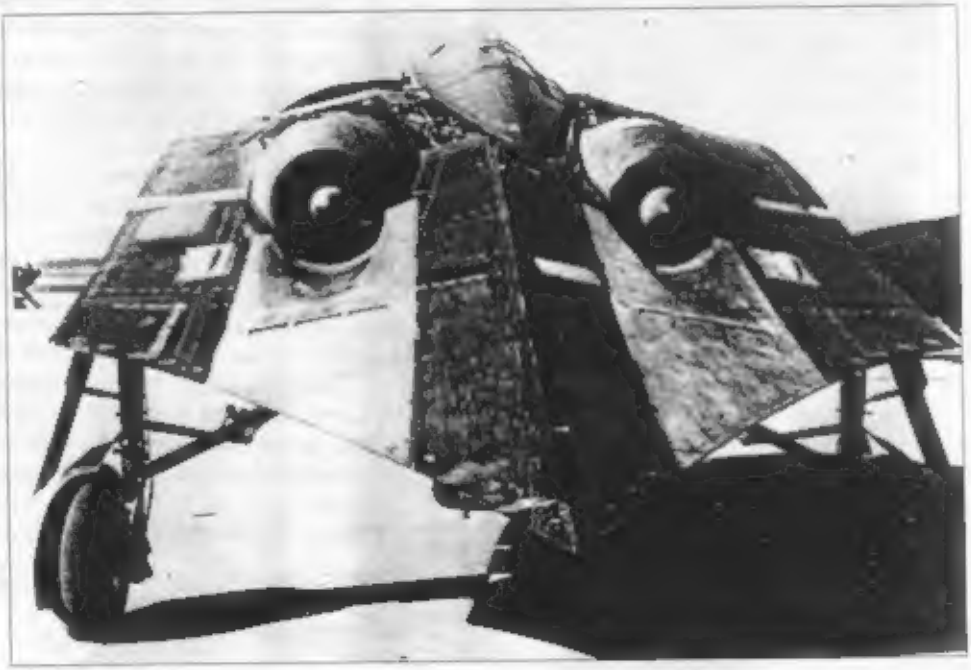
Max speed at ground level		
approx	950km/h	590mph
Initial rate of climb	16.4m/sec	53.8ft/sec
Service ceiling*	15,000-16,000m	49,000-52,500ft
Range	2,080km	1,292 miles
Range with max fuel load	4,600km	2,858 miles

*Powerplant data insufficient to determine exact ceiling.

Armament
Four 30mm MK 108 fixed forward firing cannon, additional 24 to 36 R4M unguided air-to-air rockets optional.

Electronic equipment
The Oberkommando der Luftwaffe (OKL – Luftwaffe High Command) specified that FuG 244 'Bremen 0' search radar was to be installed. This could be accommodated quite easily in the nose section.

Braking
Saw toothed ventral brake under centre section. Braking parachute reefed (gathered in) and streeded.

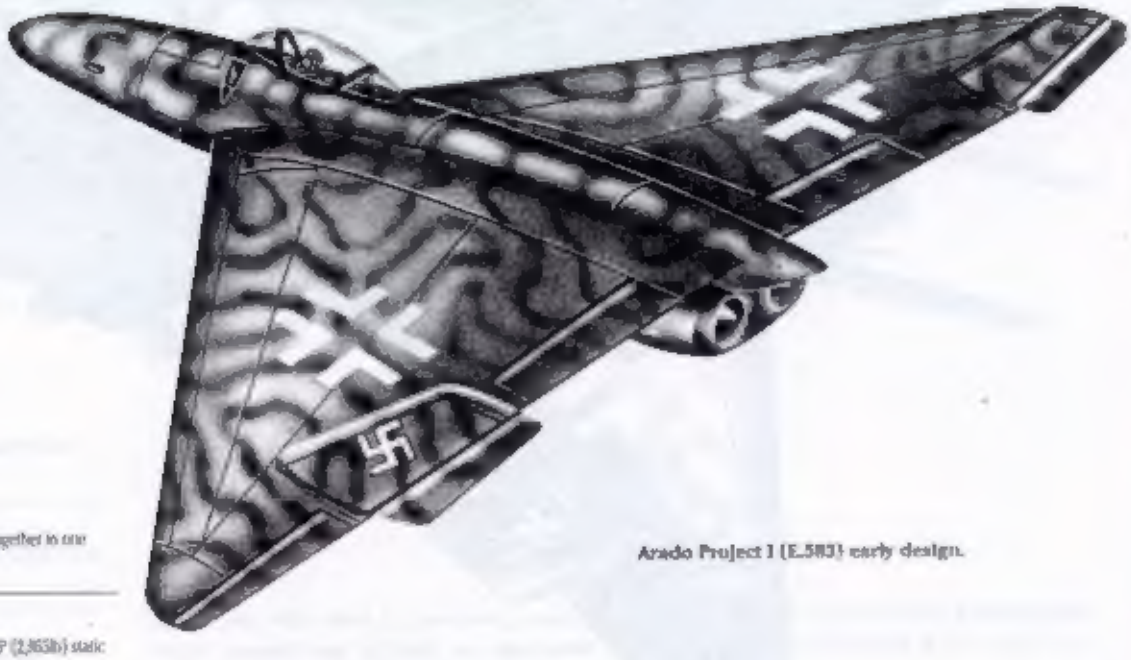


Top right: **Ho IX second prototype under construction.**

Centre right and bottom right: **Two views of the uncompleted Ho IX V3 centre section. This is held in storage at Silver Hill, Maryland, by the US National Air and Space Museum.**

Arado Project I

January-March 1945



Arado Project I (E.583) early design.

Crew
Pilot, radar operator and navigator in ejection seats together in one pressure cabin.

Powerplant
Two Heinkel HeS 011A turbojets each rated at 1,300kP (2,865lb) static thrust, semi-buried in rear fuselage.

Dimensions		
Span	18.40m	60ft 4in
Sweep	35° at 0.25 chord	
Wing area	75.0m²	807ft²
Aspect ratio	4.5 : 1	
Length overall	12.50m	41ft 0in
Height overall	3.80m	12ft 6in

Weights		
As per the Arado tender		
Empty equipped	9,300kg	20,502lb
Normal loaded	14,700kg with	32,407lb with
	5,400 litres of fuel	1,187 gallons of fuel
Max loaded	15,700kg with	34,611lb with
	6,600 litres of fuel	1,451 gallons of fuel
Max wing loading	209kg/m²	42.8lb/ft²

Performance
According to EHK comparison figures calculated with a standard specified fuel load of 4,000kg or 4,800 litres (3,616lb/1,055 gallons).

Max speed	610km/h at 9,000m	505mph at 29,500ft
Initial rate of climb	11.6m/sec	2282ft/sec
Service ceiling	12,000m	41,300ft
Max endurance* 2.15 hrs	at 450km/h	at 279mph
	at 6,000m	at 20,000ft

* With one engine shut down

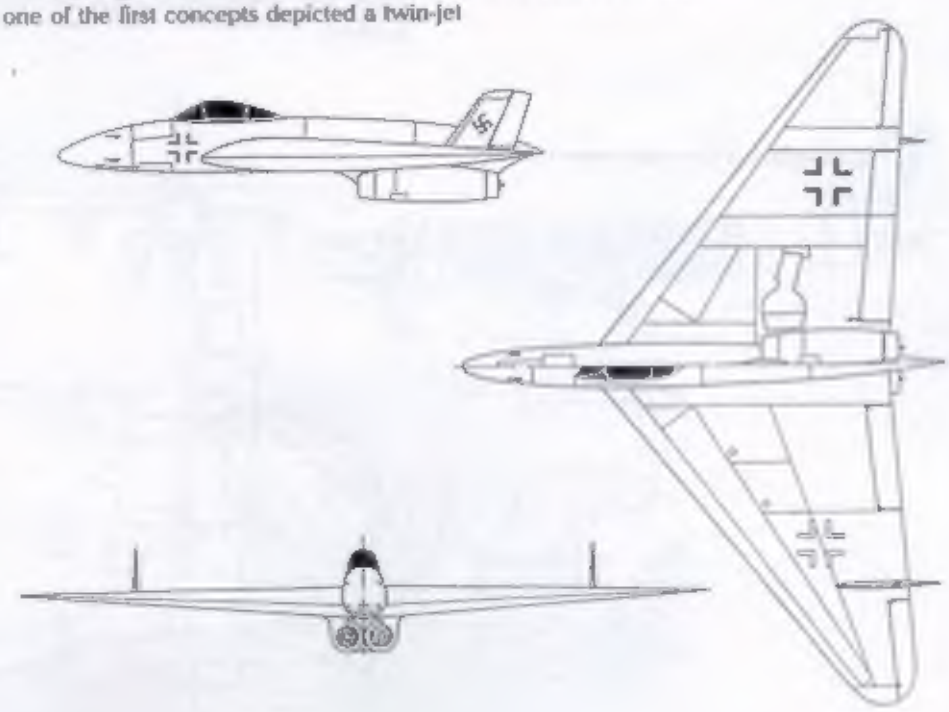
Armament (definitive version)
Two fixed forward-firing 30mm MK 213 cannon in nose, two oblique upward-firing 30mm MK 108 cannon near aircraft centre of gravity, two rearward-firing 30mm MK 213 cannon in tail as defensive armament. Weapon load: Two 500kg (1,102lb) bombs as conversion set.

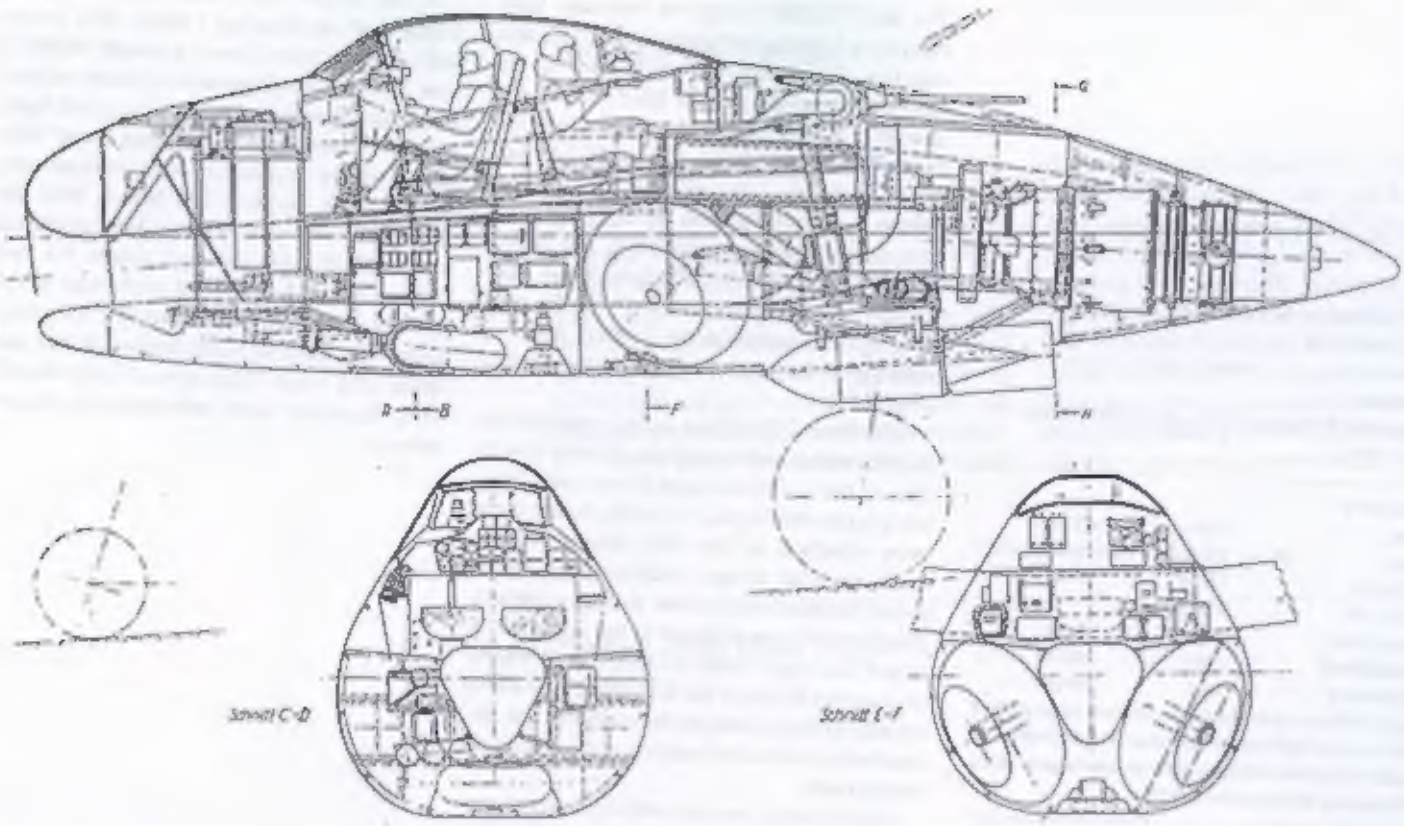
Electronic equipment
FuG 24, FuG 25, FuG 25a, FuBI 3, FuG 101, Peil G6 and AP2 6, FuG 240, FuG 250.

Aerodynamically this aircraft was based on the tail-less design studies already undertaken by Arado for the E.555 bomber project and the E.581 fighter proposal.

A characteristic of this and all other Arado tail-less night fighter designs was the wing-mounted fin and rudder assemblies which also served as boundary layer fences.

Following the 27th January specification, one of the first concepts depicted a twin-jet night and all weather fighter with an almost deltaform wingplan. In March, responding to the upgraded requirements, a larger design was completed with a broader fuselage intended to accommodate a third crew member and increased fuel capacity. This now featured a swept wing. It was in this latter form that the project was submitted by Arado to the EHK in Berlin.





Blohm und Voss P.215 tail-less night fighter.